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May 10, 2017

Via Federal Express and Email (rsbrowdy@aol.com)

Richard S. Browdy  
Chairman, Florida Building Commission  
6944 St. Augustine Road, Suite D  
Jacksonville Florida 32217

Via Federal Express and Email (keving@cfelectric.com)  
Kevin Flanagan  
Chairman, Electrical Staff Committee  
C & F Electric  
1660 NW 65<sup>th</sup> Street, Suite 5  
Plantation, Florida

**Re: Florida's Proposed Adoption of Single Acceptable Product Installation Code for  
Lightning Protection  
Section 2703.1 and Section 2703.2 Lightning Protection**

**Action Requested: Maintenance of Customer Choice by Rejecting the Proposed  
Provisions on June 13, 2017 and By Recognizing There is No Technical Basis for  
Limiting Choice to Faraday Lightning Protection Systems**

Dear Chairman Browdy and Chairman Flanagan:

Our law firm represents Heary Bros. Lightning Protection Co., Inc. ("Heary Bros.") and its division, Lightning Preventor of America.® Heary Bros. manufactures both types of lightning protection systems available in the marketplace today: (1) the traditional Faraday lightning protection systems governed by NFPA 780; and (2) its ESE lightning protection systems which have been successfully installed for over 30 years under its \$10 Million Guaranty backed by Travelers Insurance Company without a single documented lost. The Section 2703 proposals would eliminate for Florida Building owners the ESE option.

### **RECOMMENDED ACTION**

The reason that Heary Bros. offers both options to its customers is because its ESE system offers a much less expensive option while its NFPA 780 Faraday alternative is more expensive with no technical or scientific basis of superior performance to justify the added cost. Heary Bros. believes the consumer should have the option to decide. The proposed adoption of Sections 2703 and 2703.2—which Heary Bros. learned about for the first time in recent weeks—

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should be rejected or modified so as not to eliminate that choice for Florida owners. Accordingly, this letter urges you to reject this proposed building code change or—at a minimum—make it clear that Sections 2703.1 and 2703.2 require only that lightning protection systems be installed on buildings without limiting the options available solely to the traditional Faraday systems which are the subject of NFPA 780, thereby excluding the more recently developed technology of the ESE systems.

### **EXECUTIVE SUMMARY OF REASONS TO REJECT PROPOSED SECTIONS 2703**

As explained below, not only has it been established in the lightning protection industry that there is no scientific basis for preferring the method of installation of the Faraday system whose installations are governed by NFPA 780 over ESE lightning protection systems, but also the installation approach of the Faraday systems (which uses more cable and more terminals) renders the Faraday System more costly with no added benefit to owners and consumers.

Heary Bros. readily concedes that its profit margins with respect to the sale of the components of Faraday systems exceeds the profit margins on ESE systems because the installation design for Faraday systems requires more cables, more down runs and more terminals and connections despite the lack of any scientific basis for claiming a difference in performance of the two systems. It should come as no surprise that the proponent of this change in Florida Code is employed by a manufacturers' trade association, The Association of Electrical Equipment Manufacturers ("NEMA") who represents manufacturers and others with an interest in promoting the Faraday industry and, hence, promoting a code based on NFPA 780.

There is no difference between the quality of the components of ESE systems and Faraday systems. Notably, the components of both the Faraday System and the ESE systems are tested and approved by Underwriters' Laboratories, Inc. pursuant to UL 96 which provides the "quality control" for component parts of lightning protection systems. In contrast, NFPA 780 ONLY governs the method of installation and requires more cabling, terminals, connectors and more grounding because of differences in the terminals used by each of these two competing systems.

Other factors to consider are that NFPA itself discloses that NFPA 780 has no scientific basis and has never recommended that this standard be adopted as "code." Further, the author of this letter made presentations to New York State when it considered adopting a similar code change more than two decades ago and New York State ultimately rejected the very code change now before you—a change virtually identical to that being proposed here—and ruled that there was "no technical justification" for its adoption. Again, the proposed change in law imposes more costs on building owners with no scientific or practical justification.

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As to the evidence of "insurance savings" put forth by the proponents of this change in law, their evidence merely confirms that lightning protection—may in some instances—results in insurance rebates, but the documentation does not show that only NFPA 780 systems are eligible for such rebates. Moreover, what is indisputable is that the Faraday systems governed by NFPA systems are NOT eligible for Heary Bros. \$10 million guaranty backed by Travelers Insurance Company which Travelers offers only for ESE systems installed in compliance with Heary Bros.' manufacturer's standard—coverage which is provided based on Heary Bros.' field experience with this type of system that exceeds thirty years. Copies of documentation demonstrating this insurance coverage are attached hereto as Exhibit A.

Finally, it should be noted that this legislation would not only be anti-competitive and more costly to consumers, but it would deprive owners of a choice as to the type of lightning protection system to install on their buildings. Perhaps the best illustration of burden that would impose on building owners is the fact that so many building owners have in the past chosen the ESE system in preference to the Faraday system governed by NFPA 780. I have attached a list—as Exhibit B hereto—of just a small sampling of Florida projects now enjoying the benefits of Heary Bros.' ESE system and \$10 Million Guaranty which include numerous government and municipal buildings, resort and recreational centers, churches and corporate buildings. The attached list (Exhibit B) consists of over 270 examples of Florida ESE installations and, again, constitutes just a small sampling of Heary Bros.' ESE installations throughout the State of Florida—all of which have been installed in compliance with Heary Bros.' manufacturer's standard and have NOT been the subject of a single documented failure. Similarly, Federal and State governments have preferred the option of Heary Bros. ESE system with its \$11 million guaranty over Faraday systems governed by NFPA 780, as evidenced by Exhibit C to this letter. Again, Exhibit C is a list of just a few examples but includes such buildings as the Huntsville Alabama Public Safety Complex, the Los Angeles Federal Building, San Diego V. A. Medical Center, the Cape Canaveral Air Force Station, the Council Building for City of Coconut Creek, Florida, the Tampa Gateway Post Office Building, the Holmes Beach Florida Baseball Field and the U.S. Naval Air Station in Milton Florida. Again, these are just a few examples taken from Exhibit C hereto which consist mostly of government installations in various States from all over the United States.

### **NFPA ITSELF MAKES CLEAR THAT NFPA 780 IS NOT SCIENTIFICALLY BASED**

The proponents of the Faraday systems governed by NFPA 780 often argue that the existence of "national standards" for Faraday Systems (such as NFPA 780 and its parallel standard UL96A) somehow demonstrates that Faraday Systems are "scientific" and "proven." These types of statements are inconsistent with the very nature of national standards in the United States. NFPA 780 itself makes it very clear in its disclosures that NFPA 780 is NOT based on science, research, records of testing or even field experience. Instead, the NFPA specifically

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includes in the preamble to NFPA 780 (and in all NFPA consensus standards) the following disclaimers as to the efficacy of such standards:

**“While the NFPA administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate or verify the accuracy of any information or the soundness of any judgments contained in its codes and standards. The NFPA disclaims liability for any personal injury, property or other damages of any nature whatsoever...directly or indirectly resulting from the ...use of, or reliance on this document. The NFPA also makes no guaranty or warranty as to the accuracy or completeness of any information published herein.”**

This excerpt from the preface to NFPA 780 is enclosed as Exhibit D. (Emphasis added.)

#### **THE LEADING INDUSTRY LITERATURE REJECTS ANY SUPERIORITY OF FARADAY SYSTEMS OVER ESE LIGHTNING PROTECTION SYSTEMS**

We have attached the most recognized studies comparing ESE systems to Faraday Systems governed by NFPA 780, including a report generated by the NFPA itself in 1999. Specifically, attached as Exhibits E and F, respectively, are pertinent excerpts from the Report of the National Institute of Standards and Technology, entitled “Literature Review and Technical Analysis of Early Streamer Emission Systems of Lightning Protection” (1995) (hereinafter “NIST Report”) and the Report of the NFPA’s Third-Party Independent Evaluation Panel entitled “Early Streamer Emission Lightning Protection Technology” (1999) (hereafter “Bryan Report”).

Both the NIST and the Bryan Report concluded that ESE systems have both an adequate theoretical basis and laboratory testing. NIST Report at page 25; Bryan Report at page 26. However, the authors of both reports found that there is insufficient field testing of either ESE systems or traditional (also known as “Faraday”) systems of lightning protection under natural thunderstorm conditions. NIST Report at page. 16. Bryan Report at page 26. These findings of inadequate field testing of both traditional Faraday systems and ESE systems of lightning protection were based in part on the fact that there have been reported failures of both types of systems, and there was virtually no documentation to determine the cause of the failure.<sup>1</sup> As a result, both reports concluded that no meaningful conclusions regarding the performance of

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<sup>1</sup> Both Faraday and ESE Systems—like other products—sometimes experience failures due to failure to maintain the systems properly or due to installation errors. Faraday Systems rely on their “track record” in field to support their efficacy. ESE Systems, like Faraday System, also have similar field experience. For example, in over twenty years and with thousands of systems installed in the United States, Heary Bros. have had no documented failures and their insurance carriers have paid no claims. Of course, Heary Bros.’ ESE systems are installed in compliance with its manufacturer’s standard to ensure adequate installation.



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either type of system could be drawn based on either reported failures or lack of failures of either type of system under natural thunderstorm conditions. NIST Report at page 25; Bryan Report pages.23-24.

Based on this lack of field testing---or even laboratory testing---for traditional (Faraday) systems of lightning protection, the NIST Report concluded that “insufficient quantitative data see to exist about the performance of traditional rods....” NIST at page 24. Dr. Bryan, a former member of the NFPA Standards Council, went so far as to conclude that because of a lack of field or laboratory testing, NFPA 780 systems had insufficient scientific validation to warrant an NFPA standard and recommended that NFPA 780 be “downgraded” to a recommended practice. Bryan Report at pages 27-28.

It also is worth noting that both the NIST and Bryan Reports were highly critical of studies, funded by the Faraday industry, conducted by Professor Moore and Dr. Rison of the New Mexico Institute of Mining and Technology. The NIST Report questioned whether any meaningful conclusions could be drawn based on tests conducted at elevations of 3000 m, and that the testing at this altitude “raise questions about the interpretation of such observations” NIST Report at 21.

Similarly, the Bryan Report identified several significant problems with the methodology employed by Professor Moore and Dr. Rison. The Bryan Report noted that despite reporting a “failure” of an ESE system, the ESE terminal had been damaged and--as a result--the study failed to document that the ESE terminal was even working at the time of the alleged strike within the zone of protection. Bryan Report at 17. The Bryan Report also noted that Dr. Rison’s and Professor Moore’s research questioned the efficacy of terminals used in NFPA 780 systems (Faraday Systems), noting that in four years not a single sharp pointed Franklin rod was struck. *Id.* at 18.

The lack of a scientific basis for NFPA 780 and UL 96A also has been confirmed in an article by written by Professor Martin Uman (a leading lightning protection expert who is often quoted by Faraday manufacturers) and published in the December 2002 issue of *American Meteorological Society*. The article states “[t]he theoretical justification of the traditional [Faraday] approach is fairly crude, in part due to our incomplete understanding of lightning’s attachment to ground-based objects. Hence, the fact that traditional [Faraday lightning protection] systems have a history of success in preventing or minimizing damage to structures is the primary justification for their use.” December 2002 Edition of *American Meteorological Society* at page 1809. Of course, as noted above, Heary Bros.’ ESE systems have the same history of success based on field experience now exceeding thirty years—success which has been acknowledged by Heary Bros.’ insurance carriers who provide insurance coverage for its ESE systems through Travelers Insurance Company.

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## **BRIEF INFORMATION ON THE PROPONENTS OF FARADAY/ NFPA 780 SYSTEMS**

The documentation on the proposal issued by the Electrical Technical Advisory Committee reflects that the “proponent” of the proposed code provisions on lightning protection is Bryan P. Holland who is a representative of the Association of Electrical Equipment Manufacturers or “NEMA.” I think it is worth noting that NEMA is a trade association which urges manufacturers of electrical equipment to join its ranks (thereby funding NEMA) because it acts effectively as a lobbyist in promoting standards and codes to benefit its members. Specifically, the NEMA website states as its purpose that “NEMA provides a forum for the development of technical standards that are in the best interests of the industry and users, advocacy of industry policies on legislative and regulatory matters and collection, analysis and dissemination of industry data.”

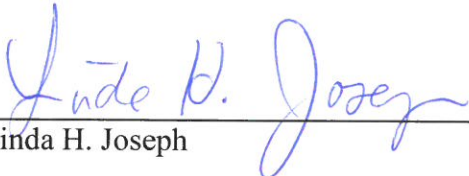
Given NEMA’s role as an advocate for its members and the fact that its membership includes cable manufacturers and at least one Faraday industry member, it is not surprising that NEMA’s representative would advocate for a code provision that would benefit the Faraday lightning protection industry and cable manufacturers. As noted above, however, there is no technical justification for giving preference to NFPA 780/Faraday lightning protection systems over ESE lightning protection systems. Moreover, eliminating the owners’ choice imposes an undue burden on building and facility owners by unnecessarily eliminating a choice that may be less expensive and more effective.

### **CONCLUSION**

For all the foregoing reasons, we respectfully request that you reject this proposed building code change or—at a minimum—make it clear that Sections 2703.1 and 2703.2 require only that lightning protection systems be installed on buildings without limiting the options available solely to the traditional Faraday systems which are the subject of NFPA 780, thereby excluding the more recently developed technology of the ESE systems. Such action is in the interests of retaining the owners’ ability to choose and will avoid the creation of state law that conflicts with federal antitrust laws and imposes anticompetitive restraints on the marketplace.

Sincerely,

**SCHRODER, JOSEPH & ASSOCIATES, LLP**

  
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COPIES BY EMAIL TO:

All Florida Building Commissioners  
All Members of the Electrical Technical Advisory Committee

Via Email ([joe.bigelow@myfloridalicense.com](mailto:joe.bigelow@myfloridalicense.com))  
Joe Bigelow, Staff Contact for the Electrical Technical Advisor Committee

**EXHIBIT A**





April 24, 2015

Heary Bros Lightning Protection Co Inc  
11291 Moore Rd  
Springville, NY 14141

To Whom It May Concern:

During the many years we have done business with Heary Brothers Lightning Protection Co. Inc., we have found your commitment to developing quality products for your customers as paramount. Included in that commitment would be the successful line of the Early Streamer Lightning Protection Equipment.

Your dedication has allowed us to establish a comprehensive and cost-effective insurance program for your companies. Because of your dedication, we have been able to secure 11 million dollars of Liability limits. This includes coverage for damage from direct lightning strikes to the structure of any buildings. Please see enclosed America Certificate of Guarantee as additional evidence.

In addition, claims activity has been negligible and we, as your broker, the The Travelers Insurance Company, as your carrier, appreciate your attention to workplace safety and products liability quality control efforts. In today's highly competitive world, this is critical.

Without a doubt, your company was built around a commitment to give customers the products they need and confidence in our ability to meet or exceed expectations. We encourage your efforts and with you continued success.

Sincerely,

A handwritten signature in black ink, appearing to read "Timothy M. Wroblewski".

Timothy M. Wroblewski  
Vice President

TW/lam

**EXHIBIT B**

# Preventor System Installations In Florida

<u>ProjectName</u>	<u>Address</u>	<u>City</u>	<u>State</u>
7000 Williams Island Building		Adventura	FL
Florida Hospital Altamonte Office		Altamonte Springs	FL
Turner Agriculture Center and Extension Office		Arcadia	FL
Marriott - Aventura Hotel		Aventura	FL
Alliant Food Service		Boca Raton	FL
Boca Museum		Boca Raton	FL
Boca Raton Condos		Boca Raton	FL
Caterpillar C-2 Expansion		Boca Raton	FL
Sears Store	Glades Road	Boca Raton	FL
TAG (The Answer Group) Main Building		Boca Raton	FL
TAG Main Building East Emissions Building		Boca Raton	FL
The Polo Club of Boca Raton		Boca Raton	FL
Bealls Corp Headquarters		Bradenton	FL
Paul Azinger Residence		Bradenton	FL
St. Stephens School		Bradenton	FL
Tara Preserve Golf Clubhouse		Bradenton	FL

<u>ProjectName</u>	<u>Address</u>	<u>City</u>	<u>State</u>
Suntree Elementary and Chiller Building		Brevard Co	FL
Florida Welcome Center		Campbelton	FL
Advanced Elastomers		Cantonement	FL
Cape Canaveral AF Station Patrick AFB Cape Arrays		Cape Canaveral	FL
Cape Canaveral Station	Patrick Air Force Ba	Cape Canaveral	FL
Satellite Assembly Bldg Cape Canaveral		Cape Canaveral	FL
Kreiseder Residence		Casey Key	FL
Silverstein Residence		Casey Key	FL
Florida Hospital		Celebration	FL
Clyde Dyal Water Treatment Plant		Christmas	FL
Citrus Springs Utilities	1360 N. Citrus Spri	Citrus Springs	FL
Baystreet Plaza @ International Mall		Clearwater	FL
Capitol One Phase IV		Clearwater	FL
Catile Tower		Clearwater	FL
Church of Scientology Sandcastle Addition		Clearwater	FL
Crescent Beach Club		Clearwater	FL
Crescent Beach Club		Clearwater	FL
General Services Bldg		Clearwater	FL



<b>ProjectName</b>	<b>Address</b>	<b>City</b>	<b>State</b>
Pinellas County Utilities		Clearwater	FL
Ruth Eckerd Hall		Clearwater	FL
Ruth Eckerd Hall - CEP Addition		Clearwater	FL
St. Cecelia Intraparochial School		Clearwater	FL
The Sirata Beach Resort		Clearwater	FL
The Tides@ Feather Sound		Clearwater	FL
Worthington Square Apartments		Clearwater	FL
City of Coconut Creek - Council Building		Coconut Creek	FL
City of Coconut Creek - Motor Pool Building		Coconut Creek	FL
Coconut Creek Public Safety		Coconut Creek	FL
Sabal Pines - Ball Field #2		Coconut Creek	FL
Sabal Pines - Elementary School		Coconut Creek	FL
Sabal Pines - Hockey Rink		Coconut Creek	FL
Sabal Pines - Maintenance Facility		Coconut Creek	FL
Sabal Pines - Pines Pavilion		Coconut Creek	FL
Sabal Pines - Soccer Field #1		Coconut Creek	FL
Body of Christ Family Life Center		College	FL
Stone/Bag Paper Container Facility	Hwy 29 & Becks La	Contonement	FL

<b>ProjectName</b>	<b>Address</b>	<b>City</b>	<b>State</b>
Alahamra Tower		Coral Gables	FL
The Alhambra Hotel/Office	50 Alhambra Circle	Coral Gables	FL
University of Miami Intra Mural Fields		Coral Gables	FL
Sheik Island Horse Farm		Dade City	FL
BCC Building 27/ New Child Develop. CTR		Davie	FL
BCC Student Services Building		Davie	FL
Nova Southeastern College Parking Garage		Davie	FL
Phil Smith Toyota		Davie	FL
Rolling Hills Golf and Country Club		Davie	FL
Daytona Auto Dealers Exchange		Daytona Beach	FL
Daytona Marriott Hotel	100 N Atlantic Ave	Daytona Beach	FL
Deerfield Beach Grand Hilton	100 Fairway Drive	Deerfield Beach	FL
Granada Royale Hotel	902 S. E. 20th Ave.	Deerfield Beach	FL
Deltona Lake Track "A"	Diamond Street	Deltona	FL
Deltona WWTP	Saxton & Agatha	Deltona	FL
Deltona WWTP	Lombardy Ctr	Deltona	FL
Deltona WWTP	Cortland Blvd	Deltona	FL
Deltona WWTP	Fisher Drive	Deltona	FL

<u>ProjectName</u>	<u>Address</u>	<u>City</u>	<u>State</u>
Well # 2 & High Service Pump	Unit 21 Sagmore Dr	Deltona	FL
Silver Beach Condominium		Destin Beach	FL
Guardian Angel School		Dunedin	FL
Our Lady of Lourdes		Dunedin	FL
Burdines Dept. Store		Fort Lauderdale	FL
Marriott - Ft Pierce Travel Plaza	Florida Turnpike Mi	Ft Pierce	FL
Granada Royale Hotel	1101 S.E. 17th Stree	Ft. Lauderdale	FL
Riverside Hotel		Ft. Lauderdale	FL
McGregor Point Hotel		Ft. Myers	FL
Raymond Building Products		Ft. Myers	FL
Raymond Building Supply Rack Storage		FT. Myers	FL
Raymond Building Supply Warehouse Building		FT. Myers	FL
Palm Court Yacht Club		Ft. Walton Beach	FL
Holy Faith Church	700 N.W. 39th Roa	Gainesville	FL
Main Library	on SR-26 Across fro	Gainesville	FL
Nordstrom Distribution Center		Gainesville	FL
UF Hotel and Conference Center		Gainesville	FL
Union Street Station		Gainesville	FL

<u>ProjectName</u>	<u>Address</u>	<u>City</u>	<u>State</u>
Jack Sawyer	608 Fairpoint Drive	Gulf Breeze	FL
Palmento General Hospital	W. 20th & W. 68th	Hialeah	FL
Aqua Penn Water Co.		High Springs	FL
City of Holmes Beach Baseball Field	5901 Marina Drive	Holmes Beach	FL
North Lake Elementary		Indian River	FL
Sebastian Highlands WTP	1001 Prineville Roa	Indian River City	FL
Richard Herrmann II Residence	405 15th Ave	Indian Rocks Beach	FL
Florida Power/Light Co Martin Combined Cycle # 3,4	State Road 710	Indiantown	FL
Martin Plant Combined Cycle 3 & 4		Indiantown	FL
Allbritton Communications.	7025 AC Skinner Pk	Jacksonville	FL
Berkman Plaza		Jacksonville	FL
Cathedral Terrace		Jacksonville	FL
Cathedral Towers		Jacksonville	FL
Cathedral Townhouses		Jacksonville	FL
Cypress Village Apartments	4600 Middleton Par	Jacksonville	FL
Sears Logistics Center		Jacksonville	FL
The Pointe		Jupiter	FL
The Phoenix @ Peachtree		Kennesaw	FL



<b>ProjectName</b>	<b>Address</b>	<b>City</b>	<b>State</b>
Dolphin Hotel - Epcot Center	1500 Epcot Resort	Lake Buena Vista	FL
Dolphin/Swan Hotel Causeway & Grotto	1500 Epcot Resort	Lake Buena Vista	FL
Royal Plaza Hotel	1905 Preview Blvd	Lake Buena Vista	FL
Swan Hotel - Epcot Center	1500 Epcot Resort	Lake Buena Vista	FL
Westgate Lakes Sales Center		Lake Buena Vista	FL
Columbia Correctional Institution		Lake City	FL
Marriott - Lake Worth Travel Plaza	Florida Turnpike Mi	Lake Worth	FL
Publix Deli Plant	PO Box 407	Lakeland	FL
RMC Ewell Corp		Lakeland	FL
FCCI Insurance Group		Lakewood Ranch	FL
US Post Office - Land O Lakes		Land O Lakes	FL
Central Catholic High School		Lecanto	FL
Citrus Co. Landfill		Lecanto	FL
St. Stalastic Church		Lecanto	FL
FDOT District 5		Leesburg	FL
Lehigh Post Office		Lehigh	FL
Ben Price Residence	Gulf of Mexico Driv	Longboat Key	FL
James Gradner Residence		Longboat Key	FL

<b>ProjectName</b>	<b>Address</b>	<b>City</b>	<b>State</b>
Sea Place Condominium Complex M1 & M2	1945 Gulf of Mexic	Longboat Key	FL
Wagner Residence	5940 Gulf of Mexic	Longboat Key	FL
Albert Whitted Expansion		Longwood	FL
Lowell Correctional Institution		Lowells	FL
St. Timothy's Catholic Church		Lutz	FL
Marco Island Pump Station	RTE 951	Marco Island	FL
South Fork High School		Martin Co.,	FL
Brevard Educational Facility		Melborne	FL
Eau Gallie High School Gymnasium & Auditorium		Melborne	FL
Brickell Station Towers	30 S.W. 8th Street	Miami	FL
Doral Concourse		Miami	FL
La Tour Condo		Miami	FL
Lincoln Financial Center	701 Brickell Ave.	Miami	FL
Marriott - Snapper Creek Travel Plaza	Florida Turnpike Mi	Miami	FL
Metropolitan Sun Bank	777 Brickell Ave	Miami	FL
Porta Vita		Miami	FL
Pro-Player Stadium		Miami	FL
Sienna		Miami	FL

<u>ProjectName</u>	<u>Address</u>	<u>City</u>	<u>State</u>
Softel Hotel	5800 Blue Lagoon	Miami	FL
Telemundo Networf		Miami	FL
Tequesta Condominium	808 Bricknell Key D	Miami	FL
Three Tequesta Point		Miami	FL
University of Miami Hecht Athletic Center		Miami	FL
University of Miami Knight Baseball Stadium & Foot		Miami	FL
University of Miami Schiff Tennis Ctr & Hecht Ath		Miami	FL
Loews Hotel & Convention Center		Miami Beach	FL
Portofino Tower		Miami Beach	FL
Sandy Park Health Care Center		Miami Beach	FL
US Naval Air Station Bldg 1406 & 1424	Whiting Field South	Milton	FL
Mulberry Post Office		Mulberry	FL
North Port St. Lucie WTP	Gulf Port Terrace	N. Port St. Lucie	FL
Collier Residence		Naples	FL
Gerry Residence	3400 Gordon Drive	Naples	FL
HorseCreek Properties Collier Equestrian Facility		Naples	FL
Horsecreek Properties Collier Equestrian Facility	Daniels Road	Naples	FL
Naples Cay Seapointe Condo	10 Seagate Drive	Naples	FL

<u>ProjectName</u>	<u>Address</u>	<u>City</u>	<u>State</u>
Royal Poinciana Country Club	Goodlette Rd	Naples	FL
The Savoy Condo	4041 Gulf Shore Blv	Naples	FL
Blazer Residence		Navarre	FL
Caribbean Resort Condo		Navarre Beach	FL
The Fountaians Condominium		New Smyrna Beach	FL
Implant Innovations Inc.		North Palm Beach	FL
King Plastics Inc.		North Port	FL
Bishop Larkin Pastoral Center	9th Avenue	North St. Petersburg	FL
Lowell Correctional Facility Water Tower		Ocala	FL
Marion Oaks Water TRT Plant	14170 S.W. 39th Av	Ocala	FL
Marriott - Turkey Travel Plaza	Florida Turnpike Mi	Ocee	FL
Marriott - Ft Drum Travel Plaza	Florida Turnpike Mi	Okeechobee	FL
BIC Manufacturing Plant(III) Myerlake		Oldsmar	FL
Florida Hospital East Orlando		Orlando	FL
Florida Hospital Orlando		Orlando	FL
Martin Marietta Conflow Area Site	Kirtland Road	Orlando	FL
Orlando Utilities Commission Power Plant		Orlando	FL
St. Johns Rive Water Management		Palatka	FL



ProjectName	Address	City	State
St. Johns River Waste Management District Office		Palatka	FL
SWA Tipping Floor Building		Palm Beach	FL
The Diplomat Hotel - Main Building		Palm Beach	FL
SWA West Central Tipping Floor		Palm Beach Co	FL
George Young United Methodist Church		Palm Harbor	FL
St. Mark Village	Rte 19	Palm Harbor	FL
William E. Dunn Water Reclamation Facility		Palm Harbor	FL
Riviera Dunes Marina		Palmetto	FL
St. Andrews Condo		Panama City	FL
Hidden Dunes Condominium		Panama City Beach	FL
Landmark Holiday Beach Resort		Panama City Beach	FL
The Summit Resort	Thomas Drive	Panama City Beach	FL
Camp-O-Pines Pensacola Christian College		Pensacola	FL
Ellyson Industrial Park	Ellyson Field Proj	Pensacola	FL
Gelman Sciences	8780 Fly Road	Pensacola	FL
George Estes Residence		Pensacola	FL
Girls Parking Garage -Pensacola Christian College		Pensacola	FL
H-6 Academic Building		Pensacola	FL

ProjectName	Address	City	State
McKenzie Building- Pensacola Christian College		Pensacola	FL
Phoenix 10 Condominium		Pensacola	FL
University of West FL Admin. Building		Pensacola	FL
University of West FL Classroom Building		Pensacola	FL
Sabine Yacht & Racquet Club	330 Fort Pickens Rd	Pensacola Beach	FL
Eden Condominium		Peridido Key	FL
St. Clements Catholic Church		Plant City	FL
American Heritage Fine Arts Building		Plantation	FL
Crossroads 4		Plantation	FL
Motorola		Plantation	FL
Motorola Inc.		Plantation	FL
Spa Atlantis		Pompano	FL
Ligi Tool		Pompano Beach	FL
Marriott - Pompano Travel Plaza	Florida Turnpike Mi	Pompano Beach	FL
Charlotte County Public Works		Port Charlotte	FL
Dr. Eugene Gregosh Residence		Port Charlotte	FL
East Port Environmental Services		Port Charlotte	FL
Peace River WTP	Kings Hwy	Port Charlotte	FL

<b>ProjectName</b>	<b>Address</b>	<b>City</b>	<b>State</b>
Peace River WTP	Intake Structure	Port Charlotte	FL
Port Malabar WTP		Port Malbar	FL
Bishop Larkin School		Port Richey	FL
Charlotte County Sheriff's Administration	Metro Pkwy	Punta Gorda	FL
Chateau Towers	Gulfport Blvd	S. Pasadena	FL
Espirtu Santo Catholic School		Safety Harbor	FL
The Shipley Residence		Sannibel Island	FL
Baker Electronics		Sarasota	FL
C'A' D' Zan John't Mable Rigling Home		Sarasota	FL
Davis Residence		Sarasota	FL
Ed Windemuller Residence	Saddle Oaks Estates	Sarasota	FL
Ken Miller Barn		Sarasota	FL
Lincoln Properties/ NBD Bank Building	240 N Washington	Sarasota	FL
Marina Towers Condominium		Sarasota	FL
Meridian @ The Oaks Building III		Sarasota	FL
Sarasota Herald Tribune		Sarasota	FL
Scott Sign Systems		Sarasota	FL
Scott Signs Phase II		Sarasota	FL

<b>ProjectName</b>	<b>Address</b>	<b>City</b>	<b>State</b>
Sun Hydraulics Inc.		Sarasota	FL
The Phoenix Condo	Golden Gate Point	Sarasota	FL
The Radisson Hotel Lido Beach	Ben Franklin Drive	Sarasota	FL
The Renaissance		Sarasota	FL
Sebastian WTP	Filbert Street	Sebastian	FL
Lake Jackson Post Office		Sebring	FL
St. Cloud High School		St Cloud	FL
Casa Monica Hotel		St. Augustine	FL
St. Augustine Shores	771 Alahambra	St. Augustine	FL
Marriott - Canoe Creek Travel Plaza	Florida Turnpike Mi	St. Cloud	FL
School "C" Osceola Co. School District		St. Cloud	FL
Incarnation Church		St. Petersburg	FL
Jabil Circuit Inc.	10800 Roosevelt Blv	St. Petersburg	FL
Midcore Parking Garage		St. Petersburg	FL
San Seair Condominiums		St. Petersburg	FL
St. Marks Family Life Center	PO Box 43022	St. Petersburg	FL
Wheelbrator Corp		St. Petersburg	FL
SECO Office Building		Sumterville	FL

<u>ProjectName</u>	<u>Address</u>	<u>City</u>	<u>State</u>
Capital One Building One	8745 Henderson Ro	Tampa	FL
Capital One Phase II Building 2 Renaissance	8745 Henderson Ro	Tampa	FL
Capital One Phase II Parking Garage	8745 Henderson Ro	Tampa	FL
Capital One Phase III Parking Garage	8745 Henderson Ro	Tampa	FL
Capital One Phase IV Flagpole	8745 Henderson Ro	Tampa	FL
Capital One Softball Field	8745 Henderson Ro	Tampa	FL
Capital One Tai Chi Building	8745 Henderson Ro	Tampa	FL
Florida Aquarium		Tampa	FL
Gateway Post Office		Tampa	FL
Group Tech		Tampa	FL
Lee Moffit Cancer Center Parking Garage		Tampa	FL
Marriott -Tampa		Tampa	FL
Muvico	18002 Richmond Pa	Tampa	FL
Myrtle Oaks		Tampa	FL
Notre Dame High School		Tampa	FL
Seaboard Waste Water TRT Plant	8234 Causeway Blv	Tampa	FL
St. Mary's Episcopal Day School		Tampa	FL
St. Pete Catholic High School		Tampa	FL

ProjectName	Address	City	State
Tampa Bay Water Groundwater Clear Well Tank		Tampa	FL
Tampa Bay Water Surface		Tampa	FL
Tampa Juvenile Detention Center		Tampa	FL
The Garrison Condo		Tampa	FL
The Sorelle Residence		Tampa	FL
Westshore Plaza Phase III Expansion		Tampa	FL
City of Titusville Blue Heron WRF		Titusville	FL
City of Titusville Blue Heron WRF		Titusville	FL
Reliant Energy Corp. Maintenance Instrumentation B		Titusville	FL
Reliant Energy Corporation Intake Structure	Highway US 1	Titusville	FL
Sipprelle Residence		Ussepa Island	FL
Meridian @ The Oaks		Venice	FL
Woodmere Clubhouse		Venice	FL
Our Lady of the Rosary-Ballfield	21010 S.R. 54	West Land O'Lakes	FL
Our Lady of the Rosary-Flagpole	21010 S.R. 54	West Land O'Lakes	FL
SWA (CMRF)		West Palm Beach	FL
Marriott - Okahumpka Travel Plaza	Florida Turnpike Mi	Wildwood	FL
Florida Hospital		Winter Park	FL

<u>ProjectName</u>	<u>Address</u>	<u>City</u>	<u>State</u>
Florida Brewing Company		Ybor City	FL

## **EXHIBIT C**



# Preventor 2005 Installations (Government)

Project Name	Address	City	State
Kodiak Building (SCAT) Mobile Structure on Rails		Kodiak	AK
Huntsville Public Safety Complex		Huntsville	AL
New Phoenix City Hall	Package Street	Phoenix	AZ
Phoenix Central Library		Phoenix	AZ
Los Angeles Federal Bldg. GSA	255 E. Temple Street	Los Angeles	CA
GSA Oakland Federal Building		Oakland	CA
California Federal Service Center	1515 Walnut Grove Avenue	Rosemead	CA
V.A. Medical Center		San Diego	CA
FBI Center New 9 Story Office Bldg		Washington	DC
Florida Welcome Center		Campbelton	FL
Cape Canaveral AF Station Patrick AFB Cape Arrays		Cape Canaveral	FL
Cape Canaveral Station	Patrick Air Force Base	Cape Canaveral	FL
Satellite Assembly Bldg Cape Canaveral		Cape Canaveral	FL
General Services Bldg		Clearwater	FL
City of Coconut Creek - Council Building		Coconut Creek	FL
City of Coconut Creek - Motor Pool Building		Coconut Creek	FL

Project Name	Address	City	State
Coconut Creek Public Safety		Coconut Creek	FL
Marriott - Ft Pierce Travel Plaza	Florida Turnpike Mile Mkr 144	Ft Pierce	FL
City of Holmes Beach Baseball Field	5901 Marina Drive	Holmes Beach	FL
Marriott - Lake Worth Travel Plaza	Florida Turnpike Mile Mrk. 94	Lake Worth	FL
US Post Office - Land O Lakes		Land O Lakes	FL
FDOT District 5		Leesburg	FL
Marriott - Snapper Creek Travel Plaza	Florida Turnpike Mile Mkr 19	Miami	FL
US Naval Air Station Bldg 1406 & 1424	Whiting Field South & North Tower	Milton	FL
Mulberry Post Office		Mulberry	FL
Marriott - Turkey Travel Plaza	Florida Turnpike Mile Mkr 263	Ocee	FL
Marriott - Ft Drum Travel Plaza	Florida Turnpike Mile Mkr 184	Okeechobee	FL
St. Johns Rive Water Management		Palatka	FL
Marriott - Pompano Travel Plaza	Florida Turnpike Mile Mrk 65	Pompano Beach	FL
East Port Environmental Services		Port Charlotte	FL
Charlotte County Sheriff's Administration	Metro Pkwy	Punta Gorda	FL
Marriott - Canoe Creek Travel Plaza	Florida Turnpike Mile Mrk 229	St. Cloud	FL
Gateway Post Office		Tampa	FL
Marriott - Okahumpka Travel Plaza	Florida Turnpike Mile Mrk 299	Wildwood	FL

Project Name	Address	City	State
Cherokee County Public Safety Complex		Canton	GA
Montgomery County Courthouse		Chula	GA
Paulding County Courthouse	Courthouse Square	Dallas	GA
Handcock Co. Courthouse		Greenfield	IN
Courthouse		Tipton	IN
Campbell County Courthouse	4th Street	Newport	KY
Westover AFB Hangar		Chicopee	MA
Westover AFB Upgrade Hangar B-700		Chicopee Falls	MA
Melrose City Hall	Essex& Main St	Melrose	MA
Natick Municipal Complex		Natick	MA
Mt. Holyoke Summit Lodge	Holyoke State Park	S. Hadley	MA
Wellesley Town Hall	525 Washington St	Wellesley	MA
Bethesda Metro Center	7450 Wisconsin Ave	Bethesda	MD
National Park		Landover	MD
Van Buren County Courthouse		Paw Paw	MI
Public Service of New Hampshire Corporate Hdqtrs.		Mancester	NH
Veterans Memorial Home	132 Evergreen Rd	Edison	NJ
Oyster Creek Emergency Bldg	Route 9	Forked River	NJ

Project Name	Address	City	State
Municipal Complex		Hanover Twp.	NJ
Manchester Town Hall	1 Colonial Drive @ Rte 37	Lakehurst	NJ
Morris County Hall of Records	Ann Street	Morristown	NJ
NJIT Library Bldg	Central Ave	Newark	NJ
South Brunswick Maintenance. Storage Complex		S. Brunswick	NJ
City Hall and Police Dept	Morris & Springfield Aves	Summit	NJ
GTE Government Systems White Sands Missile Range		WSMR	NM
State Legislature Building			NV
Yuca Mountain Test Site			NV
Regional Justice Center		Las Vegas	NV
New Reno Federal Building		Reno	NV
Galena Maintenance Station		Washoe	NV
Broadway Office Complex	625 Broadway	Albany	NY
Transitional Housing	Jackson & Cypress	Bronx	NY
Transitional Housing	141st	Bronx	NY
Transitional Housing for the Homeless	50 W. Mt Eden & Inwood	Bronx	NY
Transitional Housing	Linden Blvd	Brooklyn	NY
Transitional Housing for the Homeless	St. Johns Place & E. NY Ave.	Brooklyn	NY

<b>Project Name</b>	<b>Address</b>	<b>City</b>	<b>State</b>
Family Court Building		Buffalo	NY
The Rath County Office Building		Buffalo	NY
Tompkins County DOT Admin Facility. Bus Garage	Willow Ave	Ithaca	NY
Police & Hwy Dept Bldg	525 Pavement Road	Lancaster	NY
Niagara Falls Housing Authority-Wrobel Towers	Main Street	Niagara Falls	NY
Orchard Park Municipal Center	S-4295 South Buffalo Street	Orchard Park	NY
Criminal Courts Building		Riverhead	NY
Roosevelt Island Phase II	Building I	Roosevelt	NY
Manhasset Fire House	Prospect Rd	Thomaston	NY
West Valley Nuclear Services		West Valley	NY
Logan County Court House		Bellefontaine	OH
Wood County Court House		Bowling Green	OH
Gurnet County Courthouse		Cambridge	OH
Pickway County Courthouse		Circleville	OH
Fayette County Courthouse		Fayette	OH
Trumbull County Courthouse		Trumbull	OH
Owasso City Hall		Owasso	OK
Coudersport Court House		Coudersport	PA

<b>Project Name</b>	<b>Address</b>	<b>City</b>	<b>State</b>
Potter County Courthouse	1 East Second Street	Coudersport	PA
Cameron County Courthouse	20 East Fifth St	Emporium	PA
Emporium Court House		Emporium	PA
Valley Forge Plaza	First & Moore rd	King of Prussia	PA
Berks County Courthouse	6th & Court St,	Reading	PA
Berks County Services Center	Reed & Court Sts	Reading	PA
Elk County Court House		Ridgeway	PA
Warren County Courthouse		Warren	PA
City Hall Ave Parking Facility		Norfolk	VA
FBI Firearms Range Renov. [26m Range & Stress Obst		Quantico	VA
National Parks Service bldg	North Cascades Visitor Ctr	New Halem	WA

**EXHIBIT D**

# Preface from NFPA 780

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**EXHIBIT E**

# EARLY STREAMER EMISSION AIR TERMINALS LIGHTNING PROTECTION SYSTEMS

## LITERATURE REVIEW AND TECHNICAL ANALYSIS

Prepared by

Dr. Richard J. Van Brunt  
Thomas L. Nelson  
Samara L. Firebaugh



NATIONAL  
FIRE PROTECTION  
RESEARCH FOUNDATION

**FIRE RESEARCH**

NATIONAL FIRE PROTECTION  
RESEARCH FOUNDATION

BATTERYMARCH PARK  
QUINCY, MASSACHUSETTS, U.S.A. 02269

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January 1995

development has been established from laboratory investigations [113], considerably less is known about the dynamics and interactions of these species in a discharge compared to what is known about ions. In particular, very little is known about how they contribute to lightning discharge initiation or propagation under relevant atmospheric conditions. As with negative ions, the metastable content of the air around a lightning terminal will be affected by relative humidity and general air contamination. The influence of metastable species should not extend significantly beyond the end of a lightning rod. Their role, if anything, will be to enhance initial development of a streamer at the rod tip.

In summary, it would appear that enhancement of upward streamer initiation from an ESE terminal (compared to a conventional terminal) has a plausible physical basis. However, it would also appear that a complete and universally accepted understanding of how all ESE devices work has not yet been achieved, and it can be argued that a better understanding is needed to make meaningful quantitative comparisons between the performances of ESE and conventional devices. To reach such an understanding it will undoubtedly be necessary to address numerous basic questions such as:

1. What are the predominant streamer initiation mechanisms under different conditions of polarity, atmospheric humidity, air contamination, and terminal geometry?
2. What are the relative roles of ions, electrons, and metastable species on the development and propagation of a streamer discharge from a terminal for different conditions?
3. What is the likelihood of corona formation around a terminal and how will the presence of corona affect the ability of the terminal to launch a streamer upon approach of a lightning stroke?
4. In the case of radioactive terminals, what is the dependence of the streamer initiation probability on the intensity and type of radiation source?
5. In the case of electrically triggered devices, how does the streamer initiation probability depend on the timing and magnitude of the electrically triggered spark?
6. Also for electrically triggered devices, how reliable is the field sensor that controls the triggering, and can its performance be affected by local space charge?

Attempts to find answers to questions like these are the focus of much ongoing experimental and theoretical research, not only on lightning, but on electrical discharge phenomena in general.

#### **D. Validation of ESE System Performance**

Three general methods have been used to evaluate and test the performance of lightning protection systems, namely: 1) small-scale laboratory or outdoor tests in which lightning, or the effects of lightning are simulated by applying high-voltage impulses

lightning seldom hits a terminal regardless of whether or not it is equipped with an ESE device [182,183,215]. Although a few isolated strikes to the mountain were reported to have occurred within the supposed zones of protection of ESE terminals [183,215], it would appear that the overwhelming majority of strikes to the mountain were at considerable distance from any terminal. In any case, the failure of air terminals to attract lightning on mountain tops at elevations of 3000 m (9843 feet) or more is obviously disturbing and raises questions about the interpretation of such observations. Before any serious conclusions are drawn about the performance of lightning attractors from tests performed on mountain tops, it may be necessary to consider the perturbing effect of the mountain itself on such parameters as the surface charge distribution and electric-field profile under a thundercloud, as well as the extent that lightning strokes at such high elevations differ from those that normally occur in lower, flatter locations. It would appear that the answers to some of these questions might already be found in the literature.

It is noted in some papers that lightning that occurs at high elevations generally differs on average from that which occurs at sea level, if in no other respect than that it has less distance to cover in going from the cloud to ground [36]. At an elevation of 3000 m, the ground can be quite close to or even engulfed by the base of a storm cloud. Certainly the results from high mountain tests cannot be dismissed, and such tests should continue, as should similar tests underway at other locations [107]. The problem is how to interpret the results of these tests and infer what they might imply about air terminal performance at lower elevations, and what they indicate about the influence of mountainous or rocky terrain on the effective zone of protection of an air terminal.

The unfavorable statistical odds associated with natural lightning can be partially overcome by using artificially triggered lightning. Tests have shown that lightning can be triggered with reasonably high probability by a rocket launched into a thundercloud [124,160,190,193]. A long trailing wire is usually attached to the rocket which provides a low resistance path to guide the initial discharge and define its direction of propagation [45,120,193]. Transportable facilities have been developed for rocket triggering of lightning that can be used for testing at nearly any location [231]. Although tests of air terminals are being made using triggered lightning, there are questions that can be raised about the meaning of such tests. There is evidence that triggered lightning is unlike natural lightning both in its intensity and propagation characteristics. In particular, it has been noted that triggered lightning is of lower current than natural lightning and exhibits characteristics more like those of return strokes observed in natural lightning [78,161]. It has also been argued that triggered lightning does not satisfactorily mimic the primary stroke and is therefore unsuited for investigation of the attachment to a grounded lightning conductor, i.e. its use in evaluating air terminals would appear to be questionable [78]. The extent to which rocket-triggered lightning behaves like natural lightning seems to depend on the length of the trailing wire and the distance of the bottom end of the wire above

### *3. Radiation hazards*

In the case of ESE devices that employ radioactive materials, issues have been raised in the literature about the possible radiation hazards to humans that the use of these devices present [24,25,39,81,180,196,278]. As noted above, radioactive air terminals are banned in some countries, presumably because of perceived health hazards. It has been noted that  $^{241}\text{Am}$  sources used in lightning protection devices are not any more hazardous than similar sources approved for use in smoke detectors or static eliminators [109,167,180]. Nevertheless, there are those who argue that the public may be placed at risk from a proliferation of radioactive materials in devices that can enter the environment without adequate controls [25,81,180]. An evaluation of the health and safety aspects of radioactive sources used in air terminals lies outside the scope of this report. However, we have identified this as a serious issue that the manufacturers and users of radioactive terminals must be prepared to address.

### *4. Damage and maintenance*

Given that ESE devices likely have a structure and associated instrumentation that are more complex than conventional air terminals, questions can be raised about their susceptibility to damage during a lightning strike. The electric current and energy deposited by a lightning stroke can be sufficiently high to actually melt metallic structures and destroy electronic components. There are numerous reports of damage inflicted by the primary lightning stroke to metal parts on aircraft, etc. [70,79,138,209,237,269]. The possibility of damage means that a lightning protection device may require periodic inspection and/or maintenance that is generally not required for conventional terminals. Although this problem is pointed out [155], there seems to be very little discussion about it in the open literature.

## **IV. CONCLUSIONS**

The possible conclusions that can be drawn from an examination of the literature included in the bibliography are discussed in this section. The main conclusions of this report are briefly summarized in Section VI.

Because of the sparsity of information that can be found in the peer-reviewed literature from tests of early streamer emission air terminals, either in the laboratory or in the natural environment, it is nearly impossible to make quantitatively meaningful statements or judgements about the performance of ESE devices in comparison to conventional Franklin rods. In fact, insufficient reliable quantitative data seem to exist about the performance of conventional rods, and there seems to be an ongoing debate about the best geometrical design for conventional terminals required to achieve optimum lightning attraction efficiency.

Nearly all of the information or data that could be found on ESE device performance resulted either from tests performed by manufacturers of lightning protection sys-

tems or by those directly or indirectly employed by such manufacturers. Although abundant criticism is published by non-manufacturers about the performance of ESE devices, especially radioactive air terminals, it is seldom based on actual test data. Those on both sides of the issue invoke lack of evidence in making their case about the performance of ESE terminals. Proponents of these devices claim that a lack of credible statistical data on failure of ESE terminals proves their effectiveness; while critics of these terminals argue that a lack of evidence about the improved performance of ESE terminals over conventional terminals proves their ineffectiveness. In either case, one must beware of faulty logic, in as much as a lack of evidence never proves the lack of something.

There are reports of incidents where ESE devices failed to provide the protection specified by the manufacturer [156,158,165,215]. Statistics on the failure of conventional systems have also been documented [109]. When examining reports of "failures", one can always raise questions about their cause, e.g., whether they are primarily a consequence of exaggerated claims made by the manufacturer or a consequence of misuse (faulty installation) of the device. Reports of isolated failures raise legitimate concerns, but are seldom accompanied by enough supporting data about the event to enable a determination of why the failure occurred. Generally it is difficult to draw significant conclusions from single events that can be used to improve system design or evaluate system performance. There is no reason to believe that an air terminal is 100% efficient in attracting lightning, regardless of what kind of ESE device it uses, if any. Considering the wide range of possible atmospheric conditions and types of lightning behavior that have been recorded, it is not surprising that air terminals of all types will sometimes fail [37,201,271]. Tall structures are reported to be struck occasionally by lightning at points far below the top, i.e., outside of the "protection zone" [173,185,186]. Any claims of 100% efficiency in the performance of a lightning attractor should be viewed with skepticism. In any case, the meaning of the term "efficiency", when specified for an air terminal, should be clearly defined and understood.

A reasonable physical basis for the operation of an ESE device appears to exist in the sense that there is good evidence from laboratory investigations that the probability of initiating a streamer discharge from an electrode can be increased significantly by irradiation or electrical triggering. However, the precise amount by which this enhancement in streamer initiation improves the lightning attraction efficiency of an air terminal remains questionable. There is reason to doubt that it significantly extends the maximum range of protection. A lightning stroke that would not hit a conventional terminal because of the fact that it does not enhance the field at the terminal tip enough to allow streamer formation will also not likely hit a terminal equipped with an ESE device. (The exception would be an ESE device that significantly increases the terminal potential during the approach of a lightning stroke.) In our view, the possible advantage offered by an ESE device, if operated properly, is that it helps to insure that a streamer will be initiated if the field produced by the

## **EXHIBIT F**

**REPORT OF THE THIRD-PARTY INDEPENDENT  
EVALUATION PANEL ON THE EARLY STREAMER  
EMISSION LIGHTNING PROTECTION TECHNOLOGY**

**BY**

**John L. Bryan**

**Richard G. Biermann**

**Glenn A. Erickson**

**Submitted to the National Fire Protection Association Standards Council on  
September 1, 1999**



Rison (336) reported in 1991 on studies conducted at the Langmuir Laboratory from July 15 to August 23, 1991 to evaluate whether a radioactive ESE air terminal provided protection within a 100 meter radius as reported by the Manufacturer. The ESE device was installed on a twenty foot mast 4 meters below South Baldy Peak. Video cameras were used to record the occurrence of lightning strikes. There were two recorded lightning strikes within the 100 meter radius area during the approximate five week study, one 85 meters from the ESE device and one approximately 78 meters from the device. However, the following statement should be noted from the report:

Near the end of the test period, it was noticed that the radioactive Preventor had been damaged --the weld had broken between the spherical ball on the Preventor and the nut to which it attached. It is not certain when or how this happened. There was no evidence of tampering or vandalism. Examination of the tip of the Preventor under a microscope showed evidence of melting, such as would occur if lightning were to have struck it. Most likely, the Preventor was struck by lightning at a time when the camcorders were not turned on (when the peak was in a cloud, or a storm occurred in the early morning hours), and the lightning broke the weld.<sup>13</sup>

Thus, it might appear that the ESE device was active in a lightning strike not recorded by the video cameras utilized during the study, since there were periods during the study when the cameras were inactive.

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<sup>13</sup>Rison, William, A Study of Lightning Strikes in The Vicinity of a Radioactive Preventor, Langmuir Laboratory, New Mexico Tech., Socorro, NM, 11-8-91, p. 4.

Moore *et al.* (248) reported in 1998 a summary of all the field tests of the radioactive "Preventor" ESE device during the summers of 1990, 1991, 1993, 1994, 1995, 1996, and 1997. Moore's analysis is as follows:

In the six summers during which the "preventor" was exposed to thunderstorms overhead, lightning struck six different sites within 100 meters of the device yet the "preventor" itself was never struck.

Digitized measurements with quarter-microsecond time resolution, of the currents that flowed from the "Preventor" during two nearby lightning strikes in September 1997 showed no indication that the "Preventor" emitted any effective "early streamers". In fact, during one of these discharges, lightning struck a blunt rod located 20 meters distant yet no streamers were emitted from the "Preventor" to connect with this close strike.<sup>14</sup>

It should be noted these seven-year tests involved a single ESE device of a radioactive type. It should also be noted that Moore's (243) field studies under natural lightning conditions have questioned the validity of the effectiveness of the sharp-pointed Franklin air terminal as follows:

The failure of radioactive-ionizing and of sharply pointed air terminals to participate in lightning discharges by being pre-eminent connectors of lightning to earth is no surprise to scientists studying thunderstorms and lightning. For the past 40 years, I have been measuring the electric currents flowing into the air from both radioactive electrodes and from sharply pointed ones under the influence of the strong electric fields beneath thunderstorms but not one of my well-exposed electrodes has ever been struck by lightning.<sup>15</sup>

<sup>14</sup>Moore, C. B., William Rison, and G. D. Aulich, An Assessment of The Radioactive "Preventor" as an Early Streamer Emitting Lightning Protector, New Mexico Tech., Langmuir Laboratory for Atmospheric Research, Socorro, NM, 12-29-98, pp. 24-25.

<sup>15</sup>243. Moore, Charles B., New Mexico Tech., "Personal Communication to Subcommittee of NFPA Board of Directors", 9-4-95, p. 1.

## 2. Consideration of System Performance

It would appear the ultimate evaluation of any complete lightning protection system would be the performance of the systems as installed on buildings. The submitted materials included one reference to the failure of a conventional system with Franklin rods (328) and there was one newspaper account of a Franklin rod system failure resulting in personnel injuries. (252) There were several studies of failures of ESE lightning protection systems. (146) (220).

The failure of the Franklin rod system resulting in the eleven personnel injuries occurred at the Robert F. Kennedy stadium in Washington, D.C. on June 13, 1998. (252) Richardson reported on the failure of a Franklin rod air terminal located approximately four feet from an externally mounted camera on the building which was damaged by a lightning strike. (328)

Makerras *et al.*, (220) have reported on four cases of lightning striking buildings in Singapore from the late 1960's until the 1980's. Hartono and Robiah (146) have reported on ten cases of failures on buildings protected with ESE lightning protection systems. This study utilized photographs of the building conditions both before and after the reported lightning strikes on the damaged areas of the buildings. It was found from this photographic study the damage appeared to be dependent on the number of strokes received, the strength of the lightning stroke and

the shape of the structure at the point of the stroke. Although not specified in the study Hartono and Robiah have indicated lightning strike damage was found on buildings protected with Franklin air terminals as indicated in the following statement:

Studies conducted on the buildings equipped with the standard lightning air terminals (Franklin rod type) also exhibited similar lightning damage locations on or near the rooftop. Based on this comparison, we conclude that no advantage can be obtained by using the ESE device in protecting the building against direct lightning strikes.<sup>21</sup>

It should be noted that all of the incidents of system failure submitted to the panel lacked the necessary detailed documentation to enable a valid analysis as to the effectiveness of the system. Even the most detailed photo study lacked the necessary documentation consisting of the following:

- The manufacture and model of the air terminal. The date the installation was completed, thus establishing the age of the system when the lightning strike occurred.
- The maintenance and condition of the system when the strike occurred, including the condition of the down conductors and the grounding system.

It would appear that detailed documentation of lightning protection system operations or failures is a needed component for the evaluation of the effectiveness of lightning protection systems of all types on various buildings of differing heights and configurations.

<sup>21</sup>Hartono, Zainal Abidin and Ibrahim Robiah, A Long Term Study on The Performance of Early Streamer Emission Air Terminals in a highly Isokeraunic Region. 2-19-99, p. 2.

Van Brunt *et al.*, (369) has referenced this problem of adequate data on lightning protection system performance in the following manner:

There are reports of incidents where ESE devices failed to provide the protection specified by the manufacturer [156,158,165,215]. Statistics on the failure of conventional systems have also been documented [109]. When examining reports of "failures", one can always raise questions about their cause, e.g., whether they are primarily a consequence of exaggerated claims made by the manufacturer or a consequence of misuse (faulty installation) of the device. Reports of isolated failures raise legitimate concerns, but are seldom accompanied by enough supporting data about the event to enable a determination of why the failure occurred. Generally it is difficult to draw significant conclusions from single events that can be used to improve system design or evaluate system performance.<sup>22</sup>

Thus, given the present situation of lightning protection system performance not being a priority of the proponents of the systems, the manufacturers, the insurance companies or public officials it would appear little valid information or data relative to a validation of the theoretical basis of the systems will be obtained.

### III. RECOMMENDATIONS TO STANDARDS COUNCIL

Based on a thorough and complete evaluation of the 377 items submitted to the third-party independent panel the members of the panel have agreed in a complete consensus on the following recommendations to the National Fire Protection Association Standards Council. It should be

---

<sup>22</sup>Van Brunt, Richard J., Thomas L. Nelson, Samar L. Firebaugh, Early Streamer Emission Air Terminals Lightning Protection Systems: Literature Review and Technical Analysis. Quincy, MA, National Fire protection Research Foundation, 1-31-95, p. 25.

recognized the Standards Council is the official designated authority on any action to be taken relative to the NFPA lightning protection documents.

#### **A. Scientific and Technical Basis of ESE**

The initial question posed to the third-party independent evaluation panel was stated as: "whether the ESE lightning protection technology is scientifically and technically sound." The panel's review of the submitted materials resulted in the following determinations:

1. The ESE air terminals appear to be technically sound since they are generally equivalent to the conventional Franklin air terminal in laboratory experiments.
2. However, neither the ESE air terminals nor the conventional Franklin rod appear to be scientifically or technically sound when evaluated in field tests under natural lightning conditions.
3. The ESE lightning protection technology as currently developed in the installation of complete systems does not appear to be scientifically and technically sound in relation to the claimed areas of protection or the essentials of the grounding system.

#### **B. Adequacy of Theoretical Basis and Lab Tests**

The second specific question posed to the third-party independent review panel was stated as: "whether the ESE lightning protection technology is supported by adequate scientific-theoretical basis and



laboratory testing." The panel's review of the submitted materials resulted in the following determinations:

1. There does appear to be an adequate theoretical basis for the early streamer emission lightning protection air terminal concept and design from a physical viewpoint.
2. There does not appear to be an adequate theoretical basis for the claimed enhanced areas of protection with limited down conductors and grounding system.
3. The high voltage laboratory tests of the ESE air terminals appear to be adequate in scope and quantity, but they are limited in that they are not equivalent to an evaluation of the complete ESE lightning protection system under natural thunderstorm conditions.

### C. NFPA Lightning Protection Documents

The third-party independent evaluation panel was also directed in the Settlement Agreement as follows: "This panel, in issuing its report, shall address the following issues, and any other issues it deems relevant." The panel considered the issues of the existing NFPA 780 document titled: Standard for The Installation of Lightning Protection Systems 1997 edition. (294) and the proposed NFPA 781 document titled: Standard for Lightning Protection Systems Using Early Streamer Emission Air Terminals. (277) The panel considered the need for each document and each committee's membership and balance in accordance with NFPA

procedures. The panel's review of the submitted materials resulted in the following determinations:

1. The current NFPA 780 Committee should be discharged and the Committee should be completely restructured. The committee needs new and additional memberships in the membership categories of enforcer, consumer, user, insurance, labor, special expert and research/testing..

2. The Council should solicit memberships from prominent users such as: FAA, DOE, DOD, NASA, IBM, Reedy Creek Improvement District, phone, radio, television organizations and electric power utilities.

3. The NFPA 780 document should be reformulated as a Guide or Recommended Practice. It appears to the panel the NFPA 780 document does not meet the NFPA criteria for a standard since the recommended lightning protection system has never been scientifically or technically validated and the Franklin rod air terminals have not been validated in field tests under thunderstorm conditions. The NFPA criteria for a standard as stated in the NFPA 99 Directory (298) is as follows:

Standard --A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix, footnote, or fineprintnote and are not to be consider as part of the requirements of a standard.<sup>23</sup>

<sup>23</sup>NFPA, National Fire Protection Association 1999 Directory, Quincy, MA, 11-98, p. 52.